Efficacy of different doses of superficial cervical plexus block on pain after thyroid surgery

Tiroid cerrahisi sonrası ağrıda farklı dozlarda yüzeyel servikal pleksus bloklarının etkinliği

Superficial cervical plexus block in thyroid surgery

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Öz

Amaç: Bu çalışmada, tiroid cerrahisi sonrası ağrı palyasyonu için, bilateral yüzeyel servikal pleksus bloğunda (BYSPB) iki farklı dozda uygulanan lokal anesteziğin (LA) etkinliklerini karşılaştırmayı amaçladık. Gereç ve Yöntem: Çalışmaya 25-60 yaşları arasında American Society of Anesthesiologists (ASA) I-II sınıfında olan ve tiroid cerrahisi uygulanan toplam 50 hasta dahil edildi. Hastalar Grup T'de (intravenous hasta kontrollü analjezi (IV HKA) + BYSPB (% 0.25, 10 ml bupivakain) (n =25) ve Grup F'de (IV HKA + BYSPB (% 0.25 ± 5 ml bupivakain) (n = 25) olarak randomize edildi. Ameliyat sonrası 2., 4., 6., 12. ve 24. saatlerde ağrı için Vizüel Analog Skala (VAS) ve morfin tüketim miktarları ölçüldü. İkincil sonuçlar ise Ramsey sedasyon skalası (RSS), yan etki profili ve ek analjezik kullanımı olarak belirlendi. Bulgular: Her iki grup arasında postoperatif VAS skorları arasında istatistiksel olarak anlamlı fark yoktu (p>0.05). Morfin tüketim miktarlarında ise; 24. saat ortalama değerleri Grup F'de istatistiksel olarak anlamlı yüksek saptandı (p<0.05). Gruplar arasındaki sekonder sonuç oranında istatistiksel olarak anlamlı fark yoktu (p> 0.05). Tartışma: YSPB'da her iki farklı LA dozunun da postoperatif tiroid ameliyatı ağrısı için kullanılabileceğine inanıyoruz.

Anahtar Kelimeler

Tiroid Cerrahisi; Analjezi; Yüzeyel Servikal Pleksus Blokajı; Bupivakain; Ultrasound

Abstract

Aim: In this study, we aimed to compare the efficacies of two different doses of a local anesthetic(LA) in bilateral superficial cervical plexus block (BSCPB) for pain palliation after thyroid surgery. Material and Method: A total of 50 patients aged between 25 and 60 years, those who were in the American Society of Anesthesiologists (ASA) I-II class and underwent Thyroid surgery were included in the study. Patients were randomized to Group T (intravenous patient-controlled analgesia morphine (IV PCA) + BSCPB (%0.25 10 ml bupivacaine); (n=25) and Group F (IV PCA + BSCPB (%0.25 5 ml bupivacaine)) ;(n=25). Visual Analogue Scale (VAS) and the quantity of morphine use were evaluated at the postoperative 2nd, 4th, 6th, 12th, and 24th hours follow-up. Secondary outcomes included the Ramsey sedation scale (RSS), side effect profile, and additional analgesic use. Results: The VAS scores at 2nd, 4th, 6th, 12th and 24th hours were found to be no statistically significant difference between groups (p>0.05). The amounts of PCA morphine consumption at the postoperative 24th hours were significantly lower in Group T than in Group F (p <0.05). No statistically significant difference was found in the rate of secondary outcomes between the groups (p>0.05). Discussion: We believe that BSCPB with two different doses of LA can be used for postoperative thyroid surgery pain.

Keywords

Thyroid Surgery; Analgesia; Superficial Cervical Plexus Block; Bupivacaine; Ultrasound

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Introduction

Surgical treatment has an important role in diseases and cancers of the thyroid gland. Nowadays, the most frequent incision in the widely used thyroidectomy is the 4-6 cm long incision performed either at 1-1.5 cm below the midline cricoid cartilage or at 1.5-2 cm above the suprasternal notch at the inferior part of the neck, which is sit in natural skin creases [1,2].

Following the thyroid surgery, the severity of the pain is usually considered mild [3]. In addition to surgical incision, deep neck tissues and intraoperative position are also considered as sources of pain [4]. In two different studies which evaluated pain after thyroid surgery, the detected opioid requirement was 90%, and the mean score of visual analog scale (VAS 0-100) was measured as 69 mm; whereas in another study in which acetaminophen was used for postoperative pain, it was reported that 70% of the patients had a VAS score above than 4 [5,6]. Nowadays, multimodal analgesia is frequently used for postoperative pain [7]. In addition to intravenous (IV) drugs, Superficial Cervical Plexus Block (SCPB), which is a regional anesthesia method, is another approach used for the pain after thyroid surgery [3,7,8]. Superficial cervical plexus (SCP) consists of anterior primary rami of the C2-C4 cervical nerves and forms lesser occipital, greater auricular, transverse cervical and supraclavicular nerve branches [8,9]. Blocking SCP with local anesthetics (LA) aims to achieve analgesia at the anterior aspect of the neck [10]. There are studies in the literature in which "blind" SCPB using anatomic marked spots or SCPB accompanied by ultrasonography (USG) were performed [7-9,11]. Although the block, which is mostly used for postoperative pain, was found to be an efficient method of treatment with successful results in many studies [3,7,12], there are studies with a similar design which suggested that SCPB fails to provide sufficient analgesia for thyroid surgery [9,13,14]. Different treatment protocols in the studies (the dose and type of the LA used) could have led to differences in the outcomes of SCPB application. Although complications such as systemic toxicity and hematoma caused by LA are predicted due to the compact venous structure of the neck area, it is recommended as a safe method in the literature [15, 16]. With the use of USG in regional anesthesia applications, the rate of complications in patients decreased compared to the blind application, and it also enabled to decrease the dose of anesthetic agents used [11,17]. There are only a few studies which used USG-guided SCPB in the literature [11]. In the study conducted in 2014, its rate of efficiency was found to be similar to the blind application, and it was suggested that different doses are required [11].

In the present study, we aimed to identify the efficacy of USG-guided BSCPB on pain levels and analgesic consumption after thyroid surgery using two different doses (5 mL and 10 mL) of 0.25% bupivacaine.

Material and Method

Patients

In this prospective, randomized, controlled and double-blind study, a total of 60 patients who were scheduled for Thyroid surgery were included. A written informed consent was obtained from each patient. The study protocol was approved by the local Ethics Committee (The decision number is 2011-KAEK-25 2016/13-07. The study was conducted in accordance with the principles of Declaration of Helsinki. Patients aged between 25 and 60 years, those who were in the American Society of Anesthesiologists (ASA) I-II class and underwent Thyroid and parathyroid surgery were included in the study. Exclusion criteria were as follows: the previous history of opioid use preoperatively, re-do thyroid surgery, allergy to LA, urgent surgery, the presence of any systemic infection, retrosternal thyroid and anatomic disorder that will make surgery difficult.

A computer-generated random numbers table was used to randomized 50 patients to either Group T (IV patient-controlled analgesia (PCA) morphine + 10 ml %0.25 bupivacaine used for BSCPB; n=25) or Group F (IV PCA morphine +5 ml %0.25 bupivacaine used for BSCPB; n=25) (Figure 1).

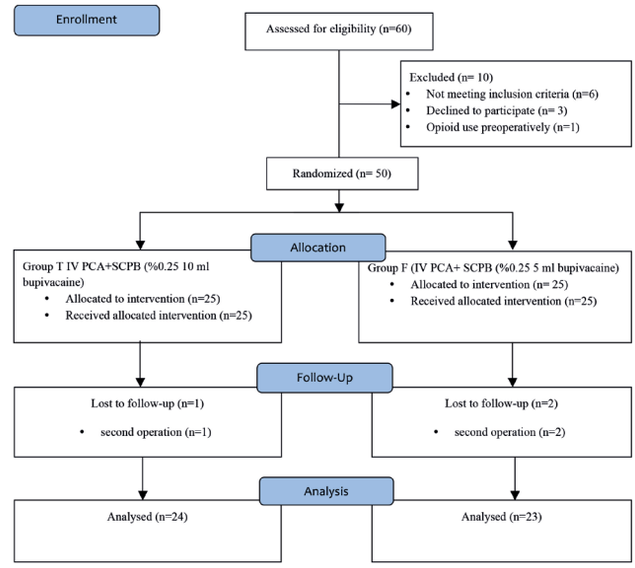

Figure 1. Consort diagram

Anesthetic management

Following premedication with IV midazolam (0.03 mg kg-1), all patients were standard monitored (non-invasive blood pressure, electrocardiography, and peripheral oxygen saturation) in the operating room. Propofol 2-2.5 mg kg-1and rocuronium bromide 0.6 mg kg-1and were administered by IV route during induction. The patients were intubated, and mechanical ventilation was performed to achieve end-tidal CO2 (ETCO2) of 30 to 35 mmHg. During maintenance of general anesthesia, sevoflurane at a concentration of 1-2.5% was administered in a 50%O2-50% air mixture. An additional need for analgesia was met by administering fentanyl at 1 μg/kg. Twenty minutes before the end of the operation, morphine infusion with IV PCA was initiated, and BSCPB under USG guidance was, then, performed. The neuromuscular reversal was provided with the administration of 0.05 mg kg-1of neostigmine and 0.02 mg kg-1of intravenous atropine at the end of surgery. In both groups, Tenoxicam 20 mg and Ondansetron 8 mg IV was applied to every patient as soon as patients are taken into the recovery room. All patients were operated by the same surgical team and anesthesiologists. When the block was applicated, the patients were under anesthesia, and after awakening, they were not informed in which group they were included. Because of this, patients were blinded to the study.

Pain management

The morphine infusion (IV PCA morphine): For Group T and Group F, the solution was prepared at a concentration of 0.5 mg/mL, following a loading dose of 1 mg. The device was programmed at, 0.5 mg of a bolus dose, 20 min of locking time, and 18 mg of maximum dose for four hours.

Bilateral Superficial cervical plexus block (BSCPB)

SCPB was performed after closing the skin incision at the end of the surgery, while the patient was in the supine position and the patient's head was slightly turned toward the opposite direction of the side to be blocked. The area of intervention was disinfected with povidone-iodine. High-frequency linear USG probe (18-Hz) was placed transversely at the level of thyroid cartilage on the lateral wall of the neck and at the midpoint of the sternocleidomastoid muscle(SCM). Upon sliding toward the posterior, prevertebral fascia and Superficial cervical plexus (small hypoechoic nodules) were visualized under the area where the SCM muscle becomes thinner [10].Using the out-of-plane technique, 10 mL of 0.25% bupivacaine was administered to Group T, and 5 mL of 0.25% bupivacaine was administered to Group F with a 22 gauge, 5 cm USG-visible peripheral nerve block needle, after confirming the location using 1 mL injection following the negative aspiration under the prevertebral fascia. Blocks were performed bilaterally using the same approach.

When Visual Analogue Scale (VAS)> 5, for additional analgesic requirement paracetamol 1 gr. was ordered to be given at a maximum of three times at eight-hour intervals.

Outcome measures

The VAS scores and morphine consumption were recorded by another investigator who was blinded to the research at the postoperative 2nd, 4th, 6th, 12th and 24th hours. Side effects including nausea and vomiting, hypotension, additional analgesic requirement, Hoarseness, Ear Numbness, and the Ramsay Sedation Scale (RSS) scores were evaluated [17,18,19]. In case of an NVS score of >3, an anti-emetic drug was administered. Hypotension was defined as a mean arterial blood pressure of <60 mmHg. Additionally, the mean depth of superficial cervical plexus under the SCM muscle at the level of the thyroid cartilage, which was detected by USG, was first measured from the lateral edge of the SCM muscle and was secondly measured from the skin at the lateral 1/3 portion of the SCM muscle. (Figure 2)

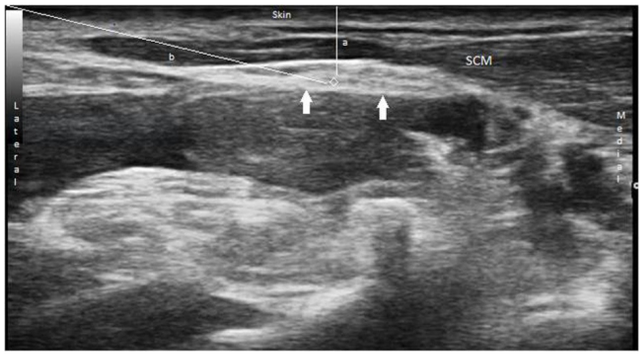

Figure 2. Depth measurements of SCP.
White arrows superficial cervical plexus a: Measurement distance between the skin and the lateral edge of the SCM (sternocleidomastoid muscle.) b: Measurement distance between the skin and the lateral 1/3 portion of the SCM muscle

Statistical Analysis

Descriptive data were expressed in frequency, percentage, mean and standard deviation. The chi-square test (x2) was used to compare qualitative data. The normal distribution of the data was assessed by the Shapiro-Wilk test, and the data were normally distributed. The Student's T-test was used for inter-group comparisons, while the Friedman test was used to compare data between measurement intervals for intragroup analysis. The Tukey HSD tests were used to find the exact time point(s) causing the differences. Values with a probability lower than α=0.05 were accepted as an indicator of significant differences between the groups. Statistical analysis was performed using IBM SPSS version 22.0 software (SPSS Inc., Chicago, IL, USA). The main outcome measure of this study was a % 30 reduction in control group's VAS scores at postoperative 24 hours [3]. For a study power of 85 % (α=0.05), the required sample size per group was calculated to be 23, for a total of 46 patients. We included 25 patients in each group to secure patients dropouts for any reason.

Results

The study was completed in 47 patients; within Group T (n=24) because of the necessity of the second operation in one patient and in Group F (n=23) because of the necessity of the second operation in two patients. Of the patients, 12 were males, and 35 were females with a mean age of 41.63 (range: 58 to 24) years. There was no statistically significant difference in demographic characteristics between the groups (Table 1).

Table 1. Demographic characteristics of the patients [Mean±SD]

		Group T (n=24)	Group F (n=23)	P
Gender	Female/Male	17/7	18/5	0.564
Age(year)		42.04±10.2	41.25±9.55	0.831
Height(cm)		163.26±6.55	164.45±5.67	0.547
Weight(kg)		76.8±11.9	74.1±8.5	0.830
BMI(kg/m^2)		28.68±5.07	27.4±3.4	0.425
Indications for surgery	Thyroidectomy	19	17	0.595
	Parathyroidectomy	5	6	

Group T: Intravenous patient-controlled analgesia morphine (IV PCA) + superficial cervical plexus block (SCPB) (%0.25 10 ml bupivacaine)
Group F: IV PCA+ SCPB (%0.25 5 ml bupivacaine)
BMI: Body Mass Index

The VAS scores at the postoperative 2nd, 4th, 6th, 12th and 24th hours were found to be no statistically significant difference between groups (p>0.05) (Table 2). The amounts of PCA morphine consumption at the postoperative 2nd, 4th, 6th, and 12th hours were also found to be no statistically significant difference between groups (p>0.05) (Table 3). But in Group T the amounts of PCA morphine consumption at the postoperative 24th hours were significantly lower than in Group F (p<0.05). There was no statistically significant difference in the frequency of side effects, Ear Numbness, and RSS scores between the groups (p>0.05) (Table 3). But in Group F Hoarseness was significantly lower than in Group T (p <0.05). In addition, depth measurements of SCP were correlated positively with BMI (p<0.05) (Table 4).

Furthermore, one patient in Group T and three patients in Group F needed paracetamol for rescue analgesia. However, there was no statistically significant difference between groups (p>0.05) (Table 3).

Table 2. Comparison of VAS scores between groups (Mean±SD]

VAS	2nd hour	4th hour	6th hour	12th hour	24th hour
Group T(n=24)	2.58± 1.21	2.70±1.39	2.29±1.16	3.04± 1.33	2.79±1.41
Group F(n=23)	2.56± 0.94	2.52±1.34	2.43±1.07	2.02± 1.19	2.60±1.43
P	0.850	0.686	0.673	0.485	0.588
Morphine consumption (mg)					
Group T(n=24)	1.14 ±0.31	1.64±0.69	3.56±1.32	7.54±2.84	9.31±3.64
Group F(n=23)	1.54 ±0.92	2.63±1.81	5.02±2.29	6.2±3.79	13.34±3.88
P	0.117	0.39	0.25	0.114	0.002

VAS: Visual Analogue Scale
Group T: Intravenous patient-controlled analgesia morphine (IV PCA) + superficial cervical plexus block (SCPB) (%0.25 10 ml bupivacaine)
Group F: IV PCA+ SCPB (%0.25 5 ml bupivacaine)

Table 3. Comparison of the Side Effects, Additional Analgesic Requirement, Ear Numbness, Hoarseness, Ramsay Sedation Scale (RSS) scores, and Duration of surgery between the groups [Mean±SD].

	Group T (n=24)	Group F (n=23)	P
Side Effects nausea and vomiting	1	1	0.176
Hypotension	1	0	0,142
Hoarseness	7	1	0.025
Ear Numbness	3	1	0.976
Additional Analgesic Requirement	3	1	0,429
Ramsay Sedation Scale (RSS) scores	2.39±0,49	2.25±0,442	0.304
Duration of surgery (min)	74.3±16.9	73.2±17.86	0,709

Group T: Intravenous patient-controlled analgesia morphine (IV PCA) + superficial cervical plexus block (SCPB) (%0.25 10 ml bupivacaine)
Group F: IV PCA+ SCPB (%0.25 5 ml bupivacaine)

Table 4. Depth measurements of SCP and correlations with BMI

		BMI	
	Mean±SD	Spearman's R	P
Measurement [a](n=47)	1.71 ±0.304	0.945	<0.001
Measurement [b](n=47)	1.10 ±0.37	0.672	<0.001

Measurement [a]: distance between the skin and the lateral edge of the SCM muscle. (cm)
Measurement [b]: distance between the skin and the lateral 1/3 portion of the SCM muscle (cm)
BMI: Body Mass Index(kg/m2)
*Correlation of measurements with BMI. (Spearman's rho)

Discussion

In the present study, we found no statistically significant differences in the all measures of VAS scores and additionally the rate of morphine consumption, until 12 hours between the two groups using 5 mL and 10 mL 0.25% bupivacaine in SCPB for the pain palliation following thyroidectomy operation. However, at the 24th hour, the rate of morphine consumption of the group administered with 10 mL bupivacaine was statistically significantly lower than the other group.

In the literature, there are reports of SCPB being used for the postoperative pain treatment in different surgical procedures [20,21,22]. There are different studies in the literature on the success of the application, dose of the LA, and injection techniques regarding SCPB applications for the pain after thyroid surgery [3,7,8,14]. In the study by Kesisoglou et al., in which 10 mL of 0.75% ropivacaine was used to block SCP in 100 patients, statistically significantly lower pain scores were detected in the SCPB group, and the difference was in favor of the SCPB group regarding postoperative analgesic consumption [3]. They emphasized that the objective of performing the injections into no deeper than 0.5 cm was to prevent phrenic nerve or recurrent laryngeal nerve block [3]. The results of another study which investigates the timing and efficacy of the block show that SCPB is a suggestible technique [8]. In that study in which no difference was detected in terms of efficacy between performing the block before the incision and after the operation, 10 mL of LA was used [8]. The results of a similar study in which 12 mL of 0.5% bupivacaine was used show that SCPB is suggestible in pain palliation after thyroidectomy [7]. In the study by Herbland et al., in which the dose of LA used in SCPB was similar to that of Kesisoglou et al., no statistically significant differences in the pain scores were detected between postoperative, preoperative, and control groups [9]. In another study which used a higher amount of LA (15 mL) for SCPB, three groups (SCPB, wound site infiltration, control) were compared [14]. In this study, no differences in analgesic consumption were detected between the three groups [14]. In a meta-analysis of eight RCTs, a total of 537 patients from 6 to 24-hour follow-up studies were analyzed. The results of the analysis showed that the clinical effect of SCPB in pain palliation is minimal [23]. The results of the review, which includes 69 studies with different points of view, showed that SCPB had similar or better analgesic effect and had less risk of complications, compared to deep cervical plexus block [16].

There are notable differences in the amount of the LA and application methods (application depth, number of injections) used in SCPB between the studies found in the literature [7,9,11,12]. It is possible that different results are caused by the differences in injection depth and the amount of LA due to the blind technique used in the studies. While superficial injections result in an unsuccessful block, deep block applications can lead to an increased risk of complication. We believe that anatomical and structural (weight, height, BMI) characteristics of the neck can also have an effect on the success of the block.

There are 3 studies which present opinions on the injection depth in SCPB [3,7,24]. The same successful result was achieved when injections depth was between 0.5-2 cm [3,7,24]. We suggest that the reason behind achieving the same result despite 10 mL LA was used in all injections and different injection depths were used for each injection was the excessiveness in the amount of LA in these 3 studies. In the results of our study, the mean depth of superficial cervical plexus under the SCM muscle at the level of the thyroid cartilage, which was detected by USG, was 1.71 cm from the lateral edge of the SCM muscle, and was 1.10 cm from the skin at the lateral 1/3 portion of the SCM muscle. A positive correlation between these results and BMI showed that using a fixed injection depth can affect the success of the block. The advantage of using USG is ensuring the plexus block according to the anatomical and physical characteristics through real-time visualization, thereby decreasing the rate of complication. Its second advantage is enabling the application of an effective block with less amount of LA [11].

In their study where they performed USG-guided SCPB for pain

palliation after thyroidectomy, Gürkan et al. used 10 mL of 0.25% bupivacaine and found that SCPB's postoperative VAS scores decreased, as well as the morphine consumption [11]. The results of our study showed that VAS scores of both of the USG-guided SCPB groups were similar to the literature and that the block was successful. Morphine consumption levels in the 24-hour measurement were higher in the group which received 5 mL LA. Complication rates were similar to the literature and to the group which received 10 mL LA in our study. Detected complications were hoarseness and ear numbness. We think that the ear numbness was caused by the block of the great auricular nerve, which is a branch of superficial cervical plexus [8,11]. The use of SCPB for ear surgery in the literature supports our thinking. [25]. The second complication, hoarseness, was detected after both blind applications and USG-guided block, which suggests that it could be due to the amount of drug used [11]. The possibility of the drugs applied to cervical plexus to spread through filtration due to anatomical proximity was also mentioned by Pandit et al. [26]. Less number of complications in the group which received 5 mL LA support our opinion that complications are associated with the amount of LA. Although studies on cadavers have shown that 2 mL of methylene blue can cover superficial cervical plexus, higher amounts of LA can be required after thyroid surgery since the pain is caused by deep tissues besides the skin incision [24,27]. Administration of 5 mL LA ensures sufficient SCPB for the pain after thyroidectomy. However, its decreased efficacy after 12 hours is its disadvantage.

In conclusion, for both of the different doses of anesthetics we used, USG-guided SCPB seems suggestible for the palliation of postoperative pain. Although the complication rate was lower in the group which received 5 mL LA, the level of analgesia decreases after 12 hours.

Conflict of Interest

The authors declare no conflict of interests.

Financial disclosure

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical Responsibilities

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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